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Selected US specifications from IPC sub-class A01K

(54) Particulate animal feed metering apparatus

(57) A particulate feed metering apparatus 10 for supplying feed to milking cows, includes a computer 12 programmed with knowledge of the feed requirements of individual animals to be fed, an interface 18 interconnecting the computer 12 with a feed dispensers 22. Each feed dispenser 22 has an actuator 30 operating a feed metering unit 32. The units 32 may have pivoting baffle plate (54), Fig. 2–5 (not shown) to provide metered delivery of food.

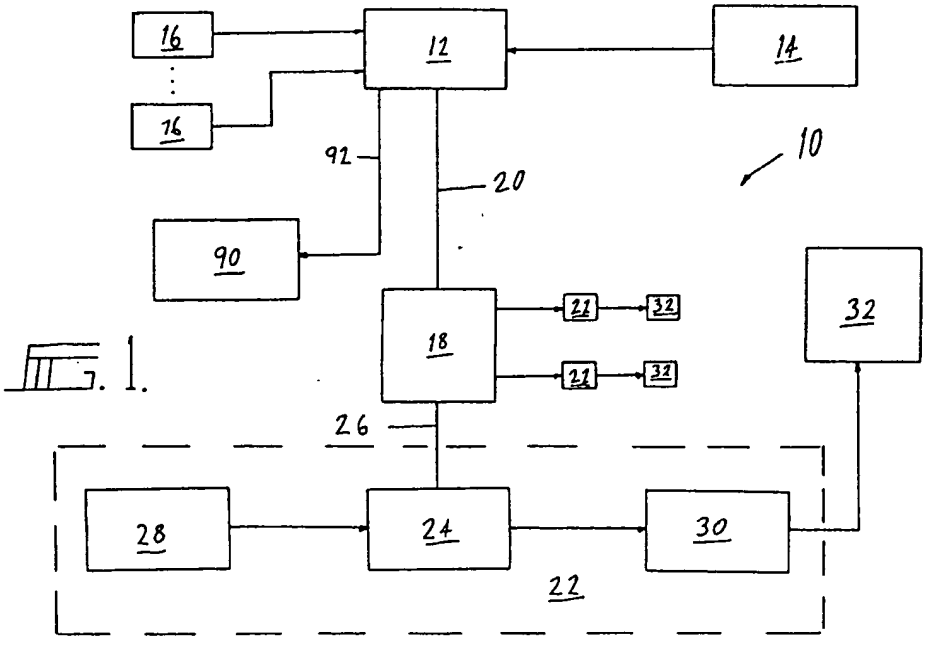

Fig. 1.

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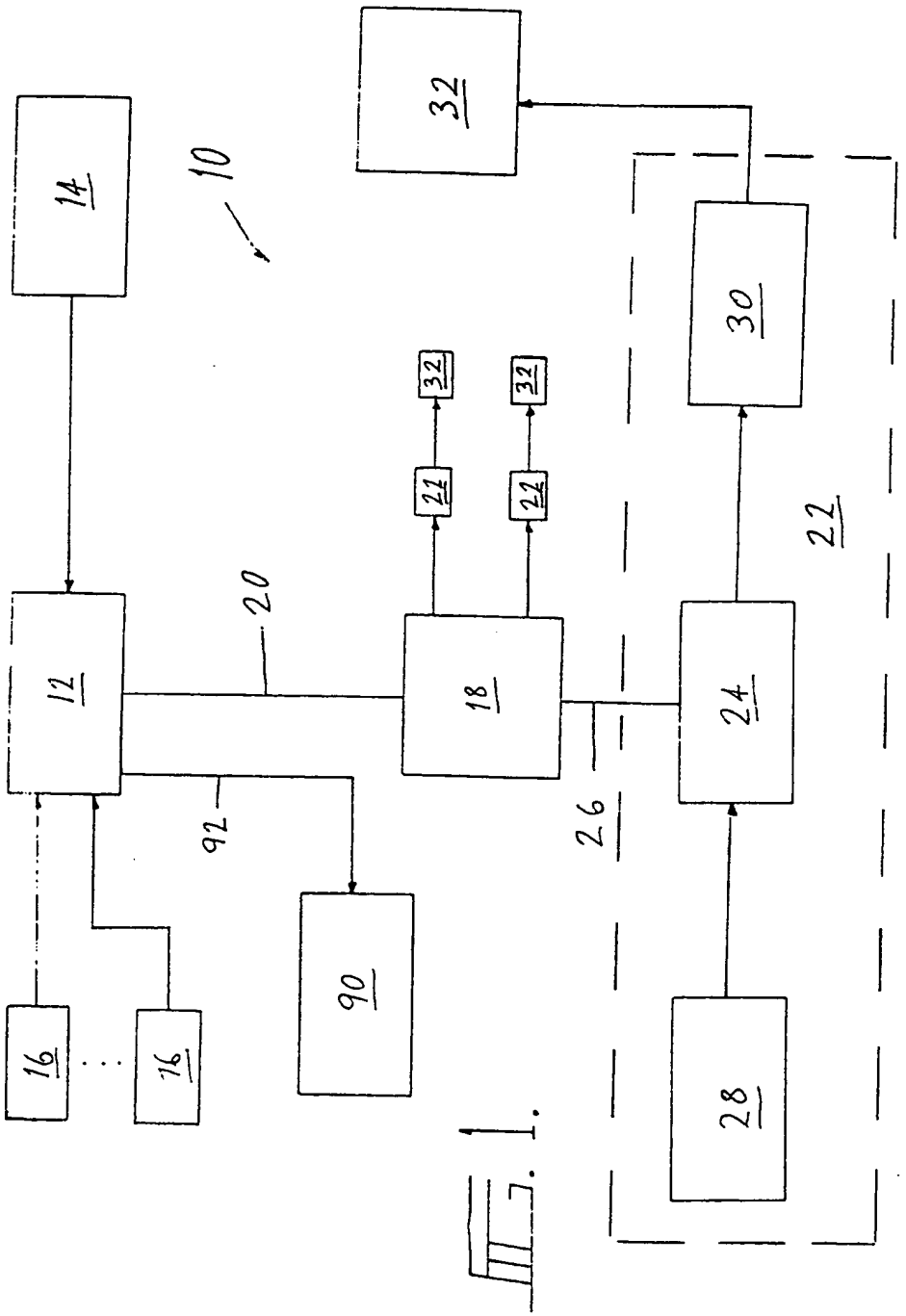

Fig. 1.

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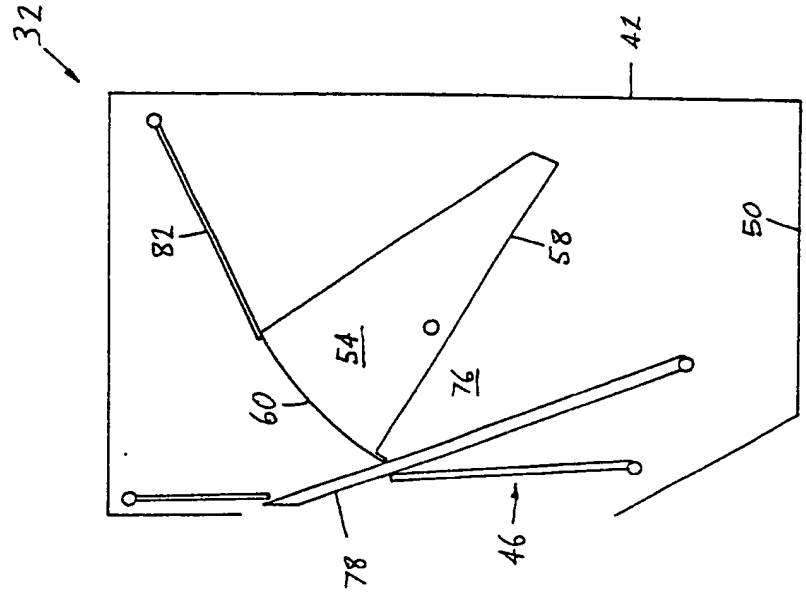

FIG. 3.

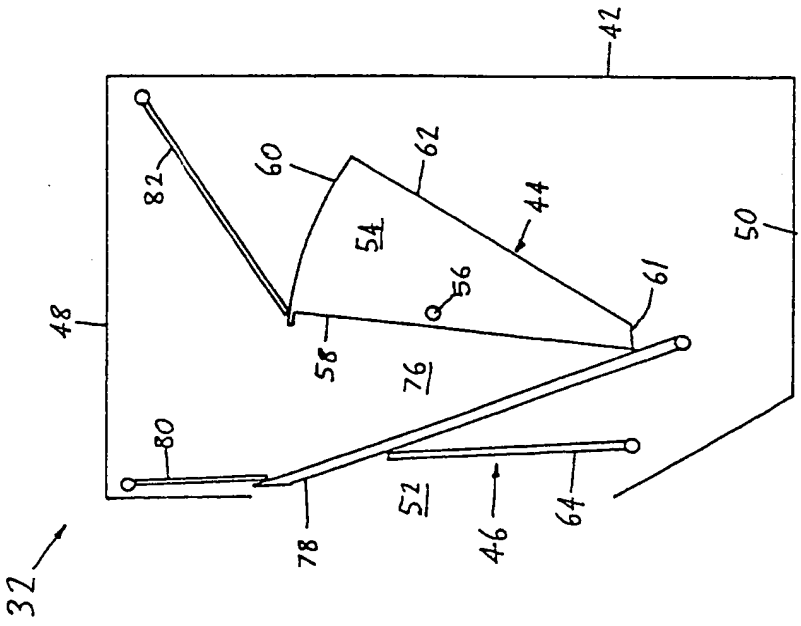

FIG. 2.

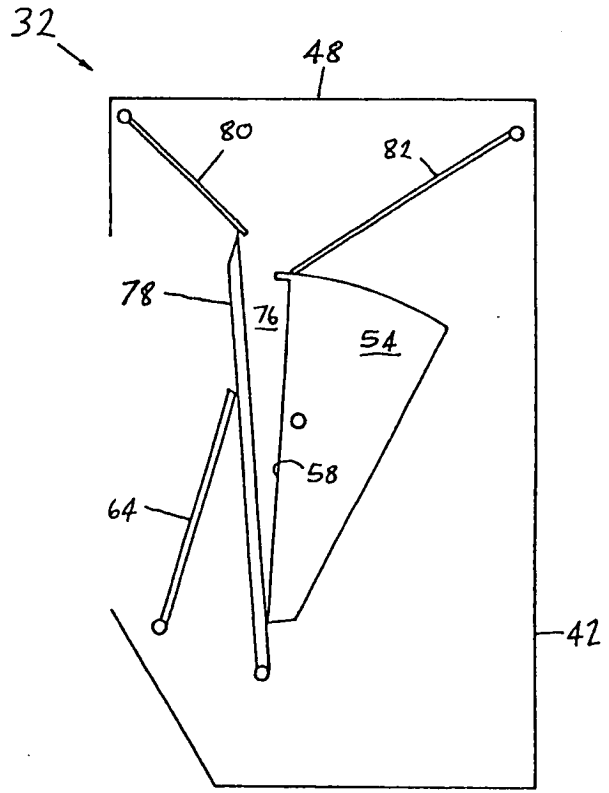

FIG. 4.

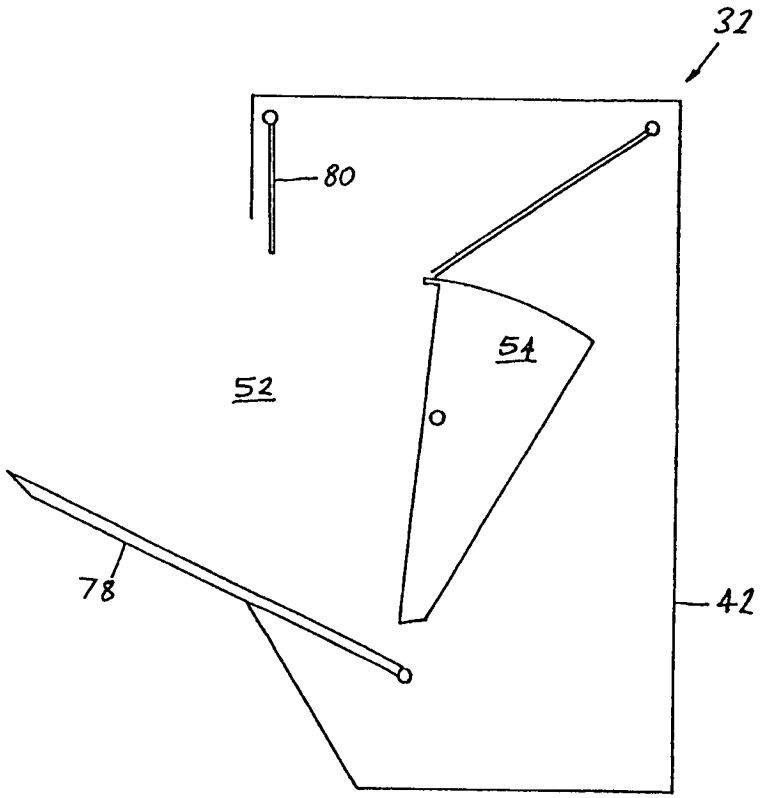

FIG. 5.

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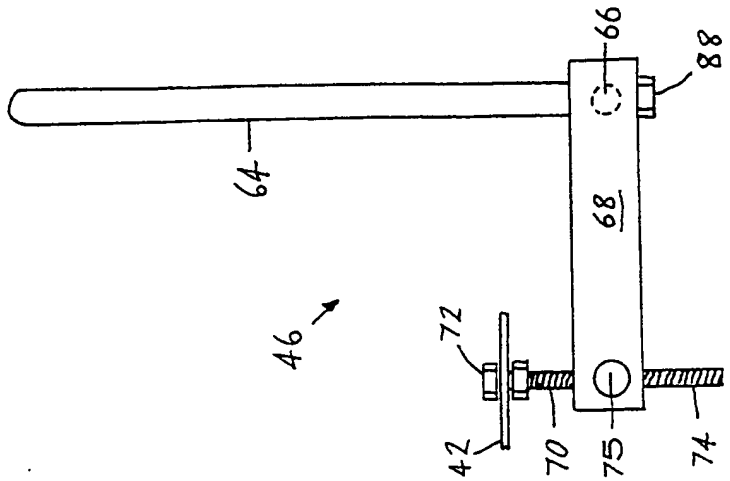

FIG. 7.

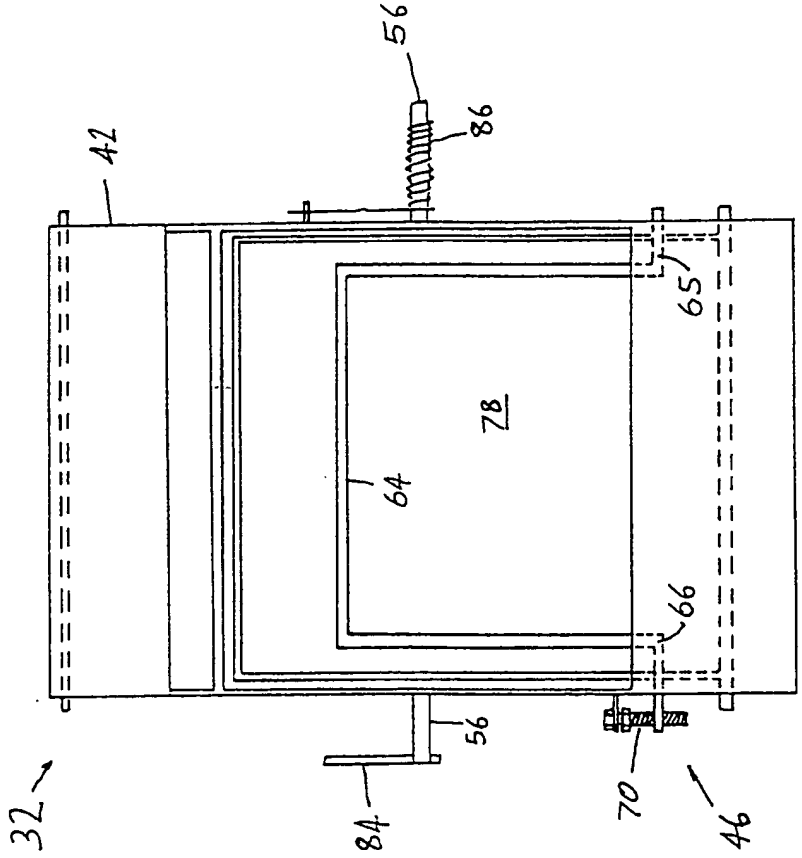

FIG. 6.

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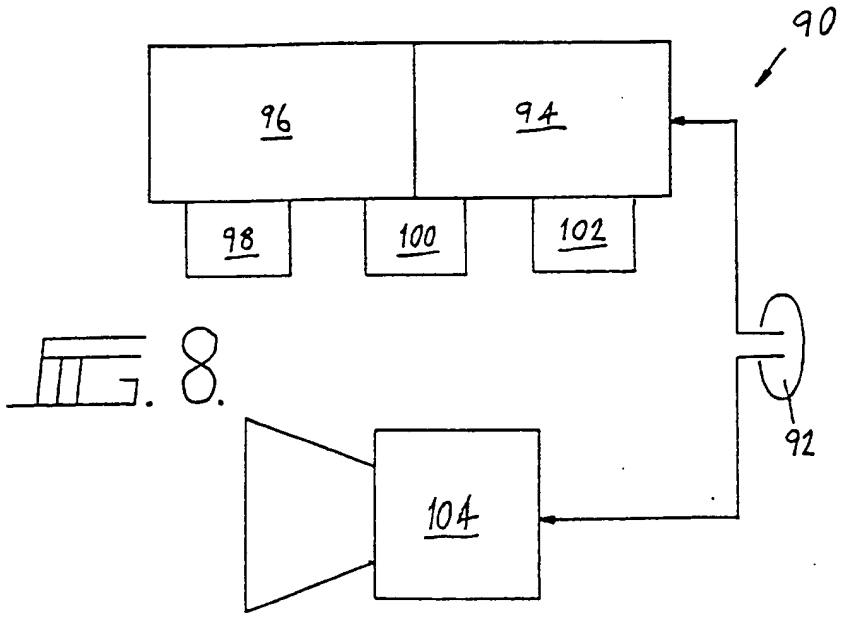

Fig. 8.

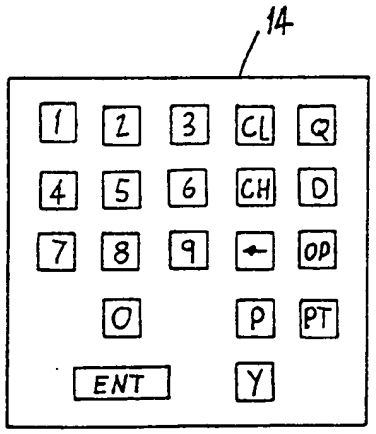

Fig. 9a.

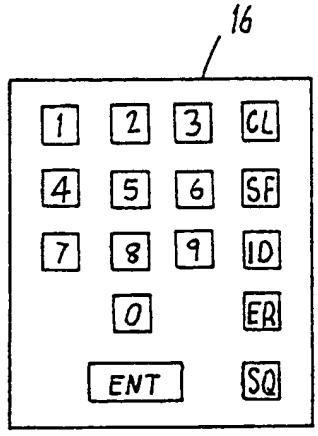

Fig. 9b.

SPECIFICATION

Particulate feed metering apparatus

The present invention relates to a particulate feed metering apparatus particularly envisaged for use in supplying particulate feed to an animal such as for example a milkingcow.

It has been found that the feed costs in seasonally or all year calving herds of milking cows represents about half the running costs of a dairy, particularly where there areperiods of poor pasture growth.

Accordingly, it is desirable to attempt to optimise the feed allotment given to each milking cow in the herd during the lactation cycle.

After calving the cows milk production increases rapidly to a peak between 5-8 weeks post-partum, the milk production then gradually decreases.

The appetite of the cow increases only gradually postpartum and reaches a peak after about 16 to 20 weeks, after which there is an equally gradual decline.

The actual milk production and the appetite of the cows varies from animal to animal and therefore the optimum feed requirements also varies. Furthermore, cows in early lactation are more efficient at converting extra feed into milk whereas cows in late lactation are less efficient.

The present invention provides a particulate feed metering apparatus to meter out amounts of particulate feed dependent upon the feed requirements of an animal to be fed.

In accordance with one aspect of the present invention there is provided a particulate feed metering apparatus for supplying particulate feed to an animal, the apparatus comprising a computer means programmed with knowledge of the feed requirements of the animal to be fed, an interface means interconnecting the computer means with a feed dispensary means, the feed dispensary means comprising an actuator controlled by the interface means to actuate a feed metering unit.

In accordance with a further aspect of the present invention there is provided a method for supplying feed to an animal, the method comprising the steps of maintaining a record of feed requirements of the animal in a computer means, adjusting the feed requirements according to transient feed requirements of the animal and actuating a feed dispensing means accordingly. The present invention will hereinafter be described with particular reference to an animal being a milking cow although it is to be understood that it is of general applicability.

The present invention will now be described, by way of example, with particular reference to the accompanying drawing in which:

Figure 1 is a schematic block representation of a particulate feed metering apparatus in accordance with the present invention;

Figure 2 is a schematic side elevation of a feed metering unit of the apparatus of Figure 1 shown with a butterfly gate in a first condition;

Figure 3 is a further schematic side elevation of the feed metering unit of Figure 2, shown with the butterfly gate in a second condition;

Figure 4 is a schematic side view of the feed metering unit of Figure 2, shown with a metering chamber at minimum capacity;

Figure 5 is a schematic side view of the feed metering unit of Figure 2, shown opened for inspection;

Figure 6 is a schematic front elevation of the feed metering unit of Figure 2;

Figure 7 is a side view of an adjustment means of the feed metering unit of Figure 2;

Figure 8 is a schematic block diagram of a status panel of the particulate feed metering apparatus of Figure 1; and

Figures 9a and 9b are plan views of a master keyboard and a remote keyboard of the particulate feed metering apparatus of Figure 1.

In Figure 1 there is shown a particulate feed metering apparatus 10 comprising a computer means 12 having connected to it a master keyboard 14 and a plurality of remote keyboards 16. The computer means 12 comprises a visual display such as for example a two line by forty character alphanumeric liquid crystal display.

The computer means 12 is programmed to receive data via the master keyboard 14 regarding an animal to be fed and being suitable to determine the feed requirements thereof. Such data may include animal type, age, sex, weight, medical history, breeding cycles, and the like together with an identification such as a number to distinguish the animal from other animals who are fed via the particulate feed metering apparatus 10. The remote keyboards 16 are located at respective feed metering units described hereinafter at which the animal is to be fed. The computer means 12 is further programmed to accept an identification number from one of the remote keyboards 16 and identifying the particular animal to be fed at the respective feed metering unit.

The particulate feed metering apparatus 10 also comprises an interface means 18 connected to an output 20 of the computer means 12. The interface means 18 is configured to boost the power of a control signal sent via the output 20.

The interface means 18 is further configured to allow switching of operation from an automatic mode, wherein the computer 12 generates the control signals, to a manual mode, wherein an operator manually provides control signals, such as via one of the remote keyboards 16. The particulate feed metering apparatus 10 further comprises a plurality of

feed dispensary means 22. In the present embodiment each of the feed dispensing means 22 comprises a solenoid valve 24 connected to a corresponding output 26 of the interface means 18. The solenoid valve 24 is conveniently interposed between a supply of compressed air 28 and a corresponding pneumatic cylinder 30. The pneumatic clyinder 30 is mechanically linked to a feed metering unit 32. The feed metering unit 32 may be of an embodiment particularly as shown in Figures 2 to 7. The feed metering unit of Figures 2 to 7 comprises a housing 42, a butterfly gate control unit 44 and an adjustment means 46.

The housing 42 comprises an inlet 48 at an upper end thereof and an outlet 50 at a lower end thereof. The inlet 48 is arranged to be attached to an overhead storage bin (not shown) containing a store of particulate feed for example. The outlet 50 is arranged to be attached to a feed trough (not shown) disposed for access to an animal to feed therefrom.

The housing 42 also comprises an inspection hatch 52 conveniently situated in the front thereof and disposed to allow access into the housing 42 for maintenance purposes and to remove blockages therefrom. When in normal use a cover (not shown) seals up the inspection hatch 52.

The butterfly gate control unit 44 comprises a baffle 54 fixed to a shaft 56. The shaft 56 is pivotably mounted into the housing 42 in a horizontal manner to allow for horizontal pivotal movement of the baffle 54 thereabout from a first condition as shown in Figure 2 to a second condition as shown in Figure 3.

The baffle comprises a front face 58, an upper curved surface 60, a lower edge 61 and one or more gussets 62 joining the upper curved surface 60 to the front face 58. Preferably, the shaft 56 is fixed to the baffle 54 intermediately of the height of the front face 58 and closer to the upper curved surface 60 than the lower edge 61. Such arrangement has preferred results as described hereinafter.

The adjustment means 46 comprises a crank mechanism 64 particularly as shown in Figures 2, 6 and 7. The crank mechanism 64 is pivotably fixed into the housing 42 and has two legs 65 and 66 extending through the housing 42 (Figure 6). The leg 66 has a lever 68 (Figure 6) fixed to it and a bolt 70 having a head 72 rotatably fixed to the housing 42 and a threaded shank 74 threadedly engaged with a toggle 75 pitotally fixed to the lever 68. Rotation of the bolt 70 produces displacement of the lever 68 up or down the shank 74 and hence pivotal movement of the crank mechanism 64 about the legs 65 and 66. There is a corresponding pivotal movement of the toggle 75. The feed metering unit 32 also comprises a metering chamber 76 as shown in Figures 2 to 5. The metering chamber 76 is defined by the front face 58 of the baffle 54 and a sealing plate 78. The sealing plate 78 is pivotably fixed to the housing 42 at one end and rests against the crank mechanism 64 adjacent an opposite end.

Pivotal movement of the crank mechanism 64 produces pivotal movement of the sealing plate 78 and adjustment of the volume of the metering chamber 76. The volume of the metering chamber 76 can thus be adjusted between a maximum approximately as shown in Figure 2 to a minimum approximately as shown in Figure 4.

Two further sealing plates 80 and 82 are provided to seal the sealing plate 78 and the curved surface 60 of the baffle 54 respectively, to the housing 42 The sealing plates 80 and 82 are also pivotally fixed into the housing 42 to allow movement with the sealing plate 78 and the curved surface 60, respectively. The sealing plates 80 and 82 thus guide the particulate material from the storage bins to the metering chamber 76.

The shaft 56 comprises a handle 84 as shown in Figure 6, protruding from the housing 42 and disposed to allow rotation of the baffle 54 between the first and the second conditions. A return spring 86 is provided to urge the baffle 54 to the first condition. The spring 86 is conveniently applied to the shaft 56 as shown in Figure 6.

The adjustment means 46 comprsies a further bolt 88 disposed to connect the leg 66 to the lever 68. The bolt 88 conveniently threadedly engages both the leg 66 and the lever 68. Removal of the bolt 88 from the leg 66 and the lever 68 allows the crank mechanism 64 to be removed from the housing 42 and the sealing plate 78 allowed to pivot forwardly as shown in Figure 5 to enable access into the housing 42 for the purposes of maintenance or to remove blockages.

The pneumatic cylinder 30 is connected to the handle 84 of the feed metering unit 32 (Figure 6) to move the butterfly gate 54 between the two operative conditions shown in Figures 2 and 3.

Each feed metering unit 32 has one of the remote keyboards 16 associated with it. Each of the remote keyboards 16 has a distinct identity with respect to the computer means 12. Hence, the computer means 12 can determine the location of a particular cow by the remote keyboard 16 associated with the relevant feed metering unit 32.

A status panel 90 is also connected to the computer means 12 via an output 92 and arranged to provide audio and/or visual information as to the status of the feed metering units 32, as shown in Figure 1. The status panel 90 preferably comprises first visual display areas 94 configured to indicate the identity of a cow at a respective one of the feed metering units 32 (see Figure 8). The status panel 90 also comprises second visual display areas 96 configured to indicate the location of

the feed metering unit 32 at which the feeding cow is stationed. Such location is determined from which one of the plurality of remote keyboards 16 is operated.

Preferably the status panel 90 also comprises a plurality of coloured lights such as for example a red light 98, a white light 100 and an amber light 102. It is intended that the red light 98 signify that the milk from the cow stationed at the feed metering unit 32 is not to be accumulated with the milk of the remainder of the herd, that is the milk is to be OFF-LINE milk. It is also intended that the white light 100 signify that the cow stationed at the feed metering unit 32 is on heat and ready to be mated. It is further intended that the amber light 102 signify that the identity of the cow stationed at the feed metering unit 32 is unknown having regard to the records contained in the computer means 12.

The first and second visual display areas 94 and 96 are also configured to display data generated by operation of one of the remote keyboards 16. For example the first display area 94 could be configured to display the letters "OL" to indicate off-line milk, "CC" to indicate commencement of calving cycle and "UA" to indicate unknown animal.

Conveniently, the status panel 90 also comprises an audio alarm such as a siren 104 connected to sound whenever one of the lights 98, 100 or 102 is illuminated so as to attract the attention of a dairyman tending the cow at the feed metering unit 32 to observe from the lights 98, 100, 102 which of the three above mentioned conditions applies to the cow.

As shown in Figure 9a the master keyboard 14 conveniently comprises twenty key pads including a ten key numeric key pad labelled 0-9 used to enter numeric data into the computer means 12. The keyboard 14 also includes a keypad labelled "ENT" used as a conventional ENTER key command to enter the numeric data. The "ENT" key is also configured to provide a default NO answer to questions raised by the computer means 12.

The keyboard 14 also comprises a key labelled "OP". The "OP" key is configured to allow entry of daily milk production and quota volumes of the herd of milking cows. A further key labelled "P" is configured to allow entry of animal records including animal identification number, ON-LINE/OFF-LINE milking status, milk production for the cow, heat cycle length for the cow and last ON HEAT date, together with system configuration and time/date entry. A further key labelled "PT" is configured to direct the computer means 12 to print the animal records, system configuration and milk production figures. A further key labelled "←" is configured to erase the right most numeric digit keyed into computer means 12 and displayed on the alphanumeric display, prior to pressingthe "ENT" key.

A further key labelled "CH" is configured to allow inspection of animal records, system configuration and milk production. A further key labelled "D" is configured to allow automatic adjustment of feed levels to the cow according to the availability of alternative feeds such as pasture.

A further key labelled "CL" is configured to erase numeric strings keyed into the computer means 12 prior to pressing the "ENT" key. A further key labelled "Q" is configured to direct the computer means 12 to quit a current function which is being executed to allow the operator tostartagainandtoexitfromprogramming-mode. The master keyboard 14 is used in configuring the computer means 12, entering herd data and retrieving accumulated data.

As shown in Figure 9b each of the remote keyboards 16 comprises a ten key numeric keypad and a clear "CL" key pad similar to that of the master keyboard 14. Each of the remote keyboards 16 also includes a key labelled "SF" configured to direct the computer means 12 to actuate the respective feed metering unit 32 to meter out a single unit of feed in a manual operation independent of the feed requirements stored in the computer means 12. A further key labelled "ID" is configured to direct the computer means 12 to display the identity number of the cow at the respective feed metering unit 32 on the status panel 90. A further key labelled "ER" is configured to direct the computer to display letter codes representative of the nature of the coloured light 98, 100 or 102 which is illuminated.

A further key labelled "SQ" is configured to direct the computer means 12 to actuate a plurality of the feed metering units 32 in sequence, such as, for example all feed metering units 32 located in a row. The sequence feed key "SQ" causes a single unit of feed to be metered out by each feed metering unit 32 in the row and with a time delay of between 5 to 20 seconds between metering out by adjacent feed metering units 32.

In use, the particulate feed metering apparatus 10 of the present invention is installed into a dairy for example, to supply, monitor and control feed provided to milking cows dependent upon the time since last the cow calved and other varient features as described hereinabove. One of the feed metering units 32 is located at each milking station to feed a cow of a herd of cows during milking. Each of the feed metering units 32 is connected to one of the pneumatic cylinders 30 as described hereinabove and thereby through one of the solenoid valves 24 to the interface means 18 and to the computer means 12.

Each of the feed metering units 32 has its inlet 48 attached to an overhead storage bin and its outlet 50 attached to a feed trough disposed for access to an animal to feed therefrom.

The volume of a unit of feed to be metered out to the feed trough is adjusted by use of the adjustment means 46 as described hereinabove.

Once the volume of the metering chamber 76 has been so adjusted particulate material may be introduced from the storage bin into the metering chamber 76 guided by the sealing plates 80 and 82.

It is intended that the size of the metering chambers 76 be set so that the volume is not greater than the smallest feed ration allotted to any particular one of the cows in the herd.

The computer means 12 is programmed to determine the number of times to actuate the feed metering unit 32 to provide a particular cow with its feed allotment. For example, cow number 123 may require five metering units 76 of feed to meet its allotment.

When the metering chamber 76 is full the handle 84 may be operated by a respective one of the solenoid valves 24 to pivot the baffle 54 about the shaft 56 to move the baffle 54 from the first condition to the second condition against the returning force of the spring 86. As the baffle 54 pivots the upper curved surface 60 moves to cut off the supply of particulate material and the lower edge 61 moves away from the sealing plate 78 to release the particulate material from the metering chamber 76.

Since the shaft 56 is closer to the upper curved surface 60 the volume between the sealing plate 78 and the front face 58, namely the metering chamber increases as the baffle 54 moves toward the second condition.

Consequently, the particulate material may freely fall under the action of the force of gravity and the upper curved surface 60 may relatively easily move to cut off the supply of the particulate material.

The result is that the feed metering unit 32 meters out a volume of particulate material from the metering chamber 76, which volume is substantially that which was set by the adjustment means 46.

Once the particulate material has been metered out of the metering chamber 76 the handle 84 may be released by the respective solenoid valve 24, at which time the spring 86 returns the baffle 54 to the first condition.

As the baffle 54 returns to the first condition particulate material begins to fall into the metering chamber 76. The lower edge 61 moves to close the bottom of the metering chamber 76 faster than the upper curved surface 60 moves to open the top of the metering chamber 76 and consequently the baffle 54 returns to the first condition before any substantial quantity of particulate material falls directly through to the outlet 50.

Conveniently one of the remote keyboards 16 is located in the vicinity of each of the feed metering units 32 and the computer means 12 and master keyboard 14 may be located at a convenient site which need not be adjacent the feed stations.

The computer means 12, prior to use, is supplied with details, as described hereinabove, of the herd of cows to be fed. Preferably, the details also include previous milk productions. The programme key "P" is used to enter the above data into the computer means 12 and to configure the system. The configuration includes specification as to the number of feed metering units 32. The quit key "Q"is then used to begin feeding. In general milking stations in a dairy are arranged in rowssuchas for example with 6 stations in one row and 6 stations in another row. In such situations the sequence feed key "SQ" directs the computer means 12 to meter out a single unit of feed (equal to the size of the metering chamber 76) to each of the feed metering units 32 in a row. Preferably, the unit 32 furtherest from the cows is sequence fed first so as to entice one of the cows into the furtherest milking station.

Preferably, there is a time delay of 5 to 20 seconds to the sequerce feeding of the next fartherest unit 32 and so on until all of the units 32 in the row have a single metering of the feed to calm down the cows whilst they are fitted to the milking machines.

As each cow is fitted to the milking machine and with the computer means 12 set to its automatic mode of operation, an operator is to enter into one of the remote keyboards 16 corresponding to the respective feed metering unit 32, the identification number for the cow to be fed thereat. Conveniently, the identification number for the cow is embossed on an ear tag. Once the cow is identified the computer means 12, based on the information previously supplied, computes the feed allotment for the particular cow and sends an automatic control signal via the output 20 to the interface means 18. The interface means 18 accordingly actuates the solenoid valve 24 and the pneumatic cylinder 30 for the particular feed metering unit 32. The pneumatic cylinder 30 then causes the butterfly gate 54 to move from the condition of Figure 2 to that of Figure 3 to meter out a predetermined volume of feed set by the volume of the metering chamber 76. Such metering is conveniently referred to as a unit of feed. The computer means 12 is configured to display the identity and location of a cow being fed, on the status panel 90, each time the feed metering unit 32 is actuated. The total number of actuations then equates to the total amount of feed allotted to the animal. During the above operation, the status panel 90 provides audible and/or visual indication of the actuation of the feed metering units 32.

Simultaneously, the computer means 12 via the interface 18 activates the siren 104 and an appropriate one of the lights 98, 100 or 102 should an alarm condition exist, such as

an OFF-LINE milking condition.

The computer means 12 is also configured to track the heat cycle of each of the cows and to sound an alarm when each of the cows is ready to be re-mated.

Typically cows have a gestation period of 264 to 300 days. The computer means is configured to activate the siren 104 and the white light 100, 56 to 60 days postpartum to indicate that the cow is ready to be re-mated. Once conception is attempted the computer means 12 allows 21 days before again sounding the siren 104 and the white light 100 to remind the dairy man to check to see if conception was successful and that the cow is pregnant. If the cow is not pregnant the computer means 12 repeats the above alarm cycle until conception is successful and registered as such.

When feeling milking cows the feed requirement is principally dependent upon the cows calving cycle. In particular once the cow has calved the cows milk output quickly increases to a maximum. During such increase the feed allotment is preferably also increased. The milk output is thus maintained about the maximum for a period of time and then gradually reduces to a level at which time further calving need be considered. With the apparatus 10 of the present invention the cows milk production and breeding cycle can be monitored and used to alter the feed allotment in order to slow the reduction in milk production of the cow and to thus increase the efficiency of milk production to feed allotment. Also the apparatus 10 adjusts the feed allotment to the requirements of each particular animal, thus giving further savings in feed useage. Modifications and variations such as would be apparent to a skilled addressee are deemed within the scope of the present invention. For example, it is envisaged that each animal could be identified automatically using a transponder configured to electronically determine the identification code. Also it is envisaged that the remote keyboards 16 could be replaced by a single hand held keyboard. Further, the apparatus 10 could be adapted to feeding other animals such as pigs. Further, the number of keys on the key boards 14 and 16 could be above or less, the labelling of the keys thereon could be altered and other functions could be provided.

CLAIMS

1. A particulate feed metering apparatus for supplying particulate feed to an animal, the apparatus comprising a computer eans programmed with knowledge of the feed requirement of the animal to be fed, an interface means interconnecting the computer means with a feed dispensary means, the feed dispensary means comprising an actuator controlled by the interface means to actuate a feed metering unit.

2. A particulate feed metering apparatus according to Claim 1, comprising a master keyboard connected to the computer means to allow entry of data relating to the feed requirements of the animal to be fed.

3. A particulate feed metering apparatus according to Claim 1 or 2, comprising a plurality of remote keyboards connected to the computer means, each remote keyboard being located adjacent one of the feed metering units and each remote keyboard having a unique identity with respect to the computer means so as to enable the computer means to differentiate between the plurality of feed metering units.

4. A particulate feed metering apparatus according to any one of the preceding claims, comprising a status panel connected to the computer means and located in view of the feed metering units, the status panel comprising a first display area configured to display an identity code for the animal being fed and a second display area configured to display a location code to signify the position of the feed metering unit at which the animal is being fed.

5. A particulate feed metering apparatus according to Claim 4, in which the status panel also comprises a plurality of coloured lights configured to be illuminated by control from the computer means upon detection of alarm conditions by the computer means.

6. A particulate feed metering apparatus according to Claim 5, in which the status panel also comprises a siren configured to sound when one or more of the coloured lights is illuminated.

7. A particulate feed metering apparatus according to any one of the preceding claims in which each of the feed metering units comprises a housing, a butterfly gate control unit located within the housing and pivotable between a first condition and a second condition, and an adjustment means disposed to adjust the pivotal movement of the butterfly gate control unit to adjust the volume of a metering chamber therein.

8. A particulate feed metering apparatus according to Claim 7, in which the butterfly gate control unit of the feed metering unit comprises a baffle pivotably fixed within the housing by a shaft, the baffle comprising a front face, an upper curved surface and a lower edge, the shaft being fixed to the baffle closer to the upper curved surface then the lower edge, the metering chamber being defined by the front face and an adjacent sealing plate such that the metering chamber has a lesser volume in a first condition with the lower edge in contact with the sealing plate than in a second condition with an edge of the upper curved surface in contact with the sealing plate.

9. A particulate feed metering apparatus according to Claim 7 or 8, in which the adjust-

ment means comprises a crank mechanism disposed in contact with the sealing plate and arranged to pivotably displace the sealing plate with respect to the front face in order to adjust the volume of the metering chamber.

10. A particulate feed metering apparatus according to any one of the Claims 7 to 9, in which the housing comprises an inspection hatch disposed to allow access to the baffle and the sealing plate.

11. A particulate feed metering apparatus according to any one of the Claims 7 to 10, in which the crank mechanism is pivotably fixed to the housing by a first and a second leg, the first leg being detachably attached to a lever and thereby to a handle, the handle being connected to the actuator to dispense a unit of feed from the metering chamber.

12. A method of supplying feed to an animal, the method comprising the steps of maintaining records of feed requirements of the animal in a computer means, adjusting the feed requirements according to transient feed requirements of the animal and ctuating a feed dispensary means accordingly.

13. A method according to Claim 12, in which a single unit of feed is delivered by a feed metering unit of the feed dispensary means to an animal being a milking cow stationed at the feed metering unit preparatory to coupling a milking machine to the cow, the single unit of feed being provided irrespective of the feed requirements stored in the computer means.

14. A method according to Claim 13, in which a single unit of feed is delivered by each feed metering unit in a row of feed metering units, there being a time delay between the delivery of the single units of feed between adjacent ones of the feed metering units such that one of the feed metering units located furthermost from the cows is activated first and one of the feed metering units nearest the cows is activated last.

15. A particulate feed metering apparatus substantially as herein described with reference to the accompanying drawings.

16. A method of feeding an animal substantiallv as herein described with reference to the accompanying drawings.

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